

Distraction Osteogenesis and Bone Grafting in Orthopedic and Maxillofacial Surgery, Role of mesenchymal Stem Cells

Raja Kummoona*

Emeritus Professor of Maxillofacial Surgery, Iraqi Board for Medical Specializations, Baghdad, Iraq

***Corresponding Author:** Raja Kummoona, Emeritus Professor of Maxillofacial Surgery, Iraqi Board for Medical Specializations, Baghdad, Iraq.

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Distraction, process of elongation of bone by stretching mechanism of periosteum and muscle after osteotomized the cortex of the bone. The pioneer work of Ilizarov, a great Russian Orthopedic surgeon and his technique was designated for elongation of lower limbs in children but before that after the 2nd world war, Ilizarov faced cases with defect in soldiers limb bones with short leg, this situation encourage this genius doctor to design distraction device for elongation of limbs, in the early ninety McCarthy did use this technique for elongation of lower jaw in cases with first arch dysplasia syndrome.

Distraction defined as the process of generating new bone by stretching distraction osteogenesis and traction on living tissue can stimulate and maintain regeneration and growth by inducing proliferation of precursor cells. This technique widely used by Orthopedic surgeons for elongation of lower limbs with polio and also been used by Maxillofacial and Craniofacial Surgeons for elongation of facial bones.

The technique of Distraction process is passing through three phases, phase one is the surgical phase, in this phase distractor device fixed to the either long bone or to the lower jaw and creation of osteotomy of the bone. The second phase is the key point and critical phase called Latent period phase, started by formation of clot in the osteotomised part of the bone with formation of granulation tissue and releasing of growth factors from platelets (PGF) and mesenchymal stem cells from the bone marrow of stumps of bone and formation of fibrous tissue oriented in the same direction of the stretching force and osteoid tissue. These cellular changes occurred during the latent period which elapsed between 3 - 7 days, this phase followed by the third phase of Consolidation phase were maturation of newly bone and osteoid tissue occurred and elapsed about 6 weeks.

We tested the distraction phenomena by experimental studies on Rabbits, these animals were subjected to experimental study by distraction technique for elongation of the mandible by using bilateral distractor designed for small bone lengthening and adjusted by Kirschner wire of 1.5 mm passed through mandibular body, rhythmed distraction of both corticomedullary fragments, rate of 1 mm per day at a rhythmic of 0.5 mm twice daily preceded by Latent period for 7 days and distraction period for 10 days, the result of this experiment after consolidation phase for 6 weeks we achieved 10 mm of mandibular lengthen.

Bone grafting is the most important technique been practiced by Maxillofacial surgeons and Orthopedic surgeons and used for reconstruction of bony defect caused by traumatic injuries either through civil road traffic accident or due to missile war injuries or after radical tumor surgery or in cases of congenital bone defect.

Bone grafting defined as surgical procedure by using transplanted bone to repair and rebuild deformity or damage bone.

The donor area either from iliac crest, tibia or ribs, the graft harvested from the iliac crest is more widely used specially in Craniofacial and Maxillofacial surgery and bone either used as cancellous or cortical cancellous or as cortical bone as autogenous bone, in Orthopedic

surgery they used autogenous and also bovine bone and used in varieties of disease as a filling in bone cyst, reconstruction of bone loss after trauma or tumor resection and osteogenesis in fracture and malunion and in end osteoarthritis of the foot and ankle causing pain and severe impairment treatment by arthrodesis. Bovine bone graft used widely by orthopedic surgeons in secondary operation of hip prosthesis displacement and reconstruction of the ankle in certain disease.

In maxillofacial surgery we do use bone grafting for reconstruction of bony defect after tumor surgery by using immediate autogenous bone graft from iliac crest as cortical cancellous bones as free graft for reconstruction for restoring the shape, esthetic and function of the jaw with rigid fixation of the graft to the jaws and our technique we ask our patient to mobilize his jaw after few days based on theory of functional demand of periosteal matrix of the facial skeleton without need for intermaxillary fixation (IMF), we been practiced this technique for the last twenty years.

Bone grafting also been used in missile war injuries as secondary stage preceded by flap surgery for reconstruction of soft tissue and for creation of bed for bone grafting, also bone graft been used in traumatic injuries of the orbital floor for correction of enophthalmos and diplopia.

Kummoona Chondro-Osseous graft been used for reconstruction of the temporomandibular joint (TMJ) in cases of ankylosed TMJ and in cases of milled cases of First Arch Syndrome, which is the most popular technique practiced nowadays.

We did research recently by experimental studies on Rabbits by reconstruction of the mandible by bone graft from iliac crest of Rabbit after excision of piece of bone from the mandible and the aim was to study the cellular changes that occur between the free bone graft and the stumps of bone of the mandible. We tested the cellular changes in 2 weeks, 4 weeks and 8 weeks, we did found the cytological changes of bone grafting showed formation of healthy granulation tissue with mesenchymal stem cells derived from bone marrow of bony segments of the mandible with platelets growth factor (PGF) and from periosteum and covering muscle with large amount of fibroblasts with tiny small blood vessels. Osteoblast was noticed more with chondrocyte and osteoid tissue.

Our finding from research carried on animal experiment by distraction technique and by bone grafting is the cellular changes associated with these two different technique is the same by presence of growth factors and mesenchymal stem cells, the only difference is the distraction is caused by expansion stress of periosteum and muscles and the bone graft by rigid fixation and decortication of both graft and stumps of bone [1-3].

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